

A TAXONOMIC STUDY OF THE ARMORED SCALE
PSEUDISCHNASPIS HEMPEL
(HOMOPTERA: COCCOIDEA: DIASPIDIDAE)¹

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Abstract.—The genus *Pseudischnaspis* includes two species, *P. acephala* Ferris and *P. bowreyi* (Cockerell). *Pseudischnaspis longissima* (Cockerell) is treated as a junior, subjective synonym of *P. bowreyi* for the first time. Lectotypes are designated where necessary. Descriptions and illustrations are given of the adult females of each species and of the first instar and adult male of *P. bowreyi*.

While preparing a description of *Pseudischnaspis bowreyi* (Cockerell) as part of a study on the economic scale insects of the United States, we discovered some conflicts between the current concepts of species in *Pseudischnaspis* and the actual identity of type specimens. The purpose of this paper is to redescribe each of the two known species (*P. acephala* Ferris and *P. bowreyi*), to place *P. longissima* (Cockerell) as a junior, subjective synonym of *P. bowreyi*, and to provide a key for the identification of the two species in the genus.

METHODS

Terminology used in the description of the first instar is that of Stoetzel and Davidson (1974b) and Howell and Tippins (1977). We have adhered to the usage of Ghauri (1962) in the male description. In the adult female we have used the terms "first space," "second space," and "third space" to refer to the interlobular area between the median lobe and lobe 2, lobe 2 and lobe 3, and lobe 3 and projections representing lobe 4, respectively.

Descriptions are based on 10 specimens from as many localities and hosts as possible. If fewer specimens were studied, we have so stated at the end of the description. We arrived at conclusions on the morphology of adult males of *Melanaspis aliena* (Newstead) based on two poor specimens, and of *M. obscura* (Comstock), *M. smilacis* (Comstock), and *M. tenebricosa* (Comstock), each based on 10 excellent specimens. Descriptions of first instars of *Pseudischnaspis bowreyi* and *Melanaspis aliena* are based on embryos; comparisons with the crawlers of *M. obscura*, *M. smilacis*, and *M. tenebricosa* are based on at least 10 excellent

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specimens collected outside of the body of the female. Numerical values are given as a range followed by an average in parentheses (rounded off to the nearest whole number). Statistical significance was determined by use of the student's t-test. Descriptions and illustrations were made using a Zeiss, Phase-Contrast Microscope with 10× eyepieces and 16×, 40×, and 100× objectives. The adult male was drawn using a zoom camera lucida attachment on a Wild, Phase-Contrast Microscope with 15× eyepieces and 10× and 20× objectives.

RESULTS

Pseudischnaspis Hempel

Pseudischnaspis Hempel, 1900: 506.

Type species.—*Pseudischnaspis linearis* Hempel, 1900 (= *P. bowreyi* (Cockerell 1893)) by original designation and monotypy.

Slide mounted characters.—The following characters occur in each species of *Pseudischnaspis* and are unique or unusual to *Pseudischnaspis* or to *Pseudischnaspis* and closely related genera.

Adult female with 3 pairs of definite lobes, area anterior of lobe 3 with series of lobelike projections; paraphysis formula usually 2-2-1, some specimens with small paraphysis attached to medial margin of lobe 3 making formula 2-3-1. Median lobe without basal sclerosis or yoke, medial margin axes parallel, lateral margins rounded, with distinct paraphysis attached to medial margin; second and third lobe simple; second lobe wider than median lobe, third lobe slightly wider than second lobe. Plates often difficult to see, with orifice of microduct at apex, posterior plate in third space represented by single narrow tine, with simple plates interspersed among projections on lateral margin of segment 5, with 2 simple plates between median lobes $\frac{1}{2}$ to equal to length of lobe. Macroducts of 2 distinct sizes, larger size located posterior of anal opening, becoming slightly smaller anteriorly, smaller size located near to or attached to narrow sclerotized area laterad of anal opening and on lateral margin of segment 4. Microducts on venter elongate, in marginal or submarginal areas of head and in submedial areas near mouthparts; microducts on dorsum shorter than those on venter. Perivulvar pores in 4 or 5 loose clusters. Perispiracular pores absent.

Dorsal seta laterad of median lobes $\frac{1}{2}$ – $\frac{3}{4}$ length of lobe. Eyes absent. Head usually with 1 or 2 tubercles in form of low dome or with apical point. Body oval in newly matured adult females, elongate in older adult females. Antenna with 1 long seta and 1 sensillum.

We have not discussed generic characters of adult males and first instars because sufficient data and specimens were unavailable.

Discussion.—Species of *Pseudischnaspis* are very similar to some species of *Melanaspis* Cockerell and very probably these species should be considered as congeneric. The only consistent difference in the adult female is the shape of the body; old adult females of species of *Pseudischnaspis* are noticeably elongate with the lateral body margins nearly parallel; old adult females of species of *Melanaspis* are round or oval with the body margins convex. Specimens of *Melanaspis aliena* and *Pseudischnaspis bowreyi* are indistinguishable except for the body shape in old adult females. These species seem to differ also in the distribution and abundance of the ventral microducts, but these differences are overlapping and have a large variance.

Table 1. Comparison of 5 characters between *Pseudischnaspis acephala* Ferris and *P. bowreyi* (Cockerell). For each character, differences between species were detected with a student's *t*-test. For each species significant differences were found for number of perivulvar pores, number of macroductal ducts, number of macroductal ducts in subunits of the second space, and the distance between the anal opening and the median lobes.

Character	Species	Mean	±Standard error	n	t-test value	Level of significance
No. perivulvar pores	acep.	10.55	0.48	40	22.25	<i>P</i> < .001
	bow.	23.14	0.73	50		
No. macroducts on pygidium	acep.	22.47	0.23	40	12.62	<i>P</i> < .001
	bow.	29.26	0.44	50		
No. macroducts between lobe 3 and interlobular paraphysis	acep.	4.32	0.06	80	16.92	<i>P</i> < .001
	bow.	6.31	0.09	100		
No. macroducts as above and anterior of paraphysis apices	acep.	2.25	0.06	80	14.48	<i>P</i> < .001
	bow.	4.04	0.10	100		
Distance between anal opening and median lobes	acep.	90.03	1.04	40	12.99	<i>P</i> < .001
	bow.	121.82	1.12	50		

We could find no morphological differences in the first instar of *Melanaspis aliena* and *Pseudischnaspis bowreyi*. We note an unusual amount of similarity among the crawlers of the above mentioned species and *Melanaspis smilacis*. These similarities are not shared by *M. obscura* and *M. tenebricosa* (for details see the discussion section of the first instar of *Pseudischnaspis bowreyi*).

In the adult male there is one noticeable difference between *M. aliena* and *Pseudischnaspis bowreyi*. It is interesting that like the first instars, the adult males of *Melanaspis smilacis* share several apparently apomorphic features with *M. aliena* and *Pseudischnaspis bowreyi* (for details see the discussion section of the adult male of *P. bowreyi*).

KEY TO SPECIES OF *PSEUDISCHNASPIS* (ADULT FEMALES)

1. With 8–13(11) perivulvar pores; usually with 4 or 5(4), rarely 6, macroduct orifices in row beginning between medial margin of third lobe and interlobular paraphysis in second space (Fig. 1B); distance between posterior apex of anal opening and base of median lobes 59–123(90) μ , rarely over 101 μ *acephala* Ferris
- With 13–31(23) perivulvar pores; usually with 5–7(6), rarely 4, 8, or 9, macroduct orifices in row beginning between medial margin of third lobe and interlobular paraphysis in second space (Fig. 2B); distance between posterior apex of anal opening and base of median lobes 91–143(122) μ , rarely under 103 μ *bowreyi* (Cockerell)

Pseudischnaspis acephala Ferris

Pseudischnaspis acephala Ferris 1941: 382.

Suggested common name.—Flatheaded scale.

Type material.—Through the courtesy of Raymond J. Gill, Department of Food and Agriculture, Sacramento, California, and Robert O. Schuster, Department of Entomology, University of California, Davis, (UCD), we have examined the syn-

type series of this species. We have selected an adult female mounted on a slide with another adult female labeled as follows: Right label "Pseudischnaspis/*acephala* Ferris/On Cavendishia/Type/Boquete/Chiriqui Province./Panama/Ferris 1938 no. 62"; left label "LECTOTYPE/Pseudischnaspis/*acephala* Ferris/PARALECTOTYPE/design. Miller, Davidson, & Stoetzel, 1984." The specimen on the right is the lectotype and a map is given on the slide showing the position of the primary type; it is deposited at UCD. In addition to the 2 specimens mentioned above there are 3 additional slides containing the following paralectotypes: 6 adult females, 4 second instar exuviae, 4 first instar exuviae, and 1 first instar; all are deposited at UCD. A single slide containing 2 adult female paralectotypes is deposited in the U.S. National Museum of Natural History Collection, Beltsville, Maryland (USNM).

Field characters.—Adult female cover black, elongate, and narrow; exuviae terminal, black. Ventral cover thick, well developed. Male cover similar in texture and color to female cover but shorter. Occurring on underside of leaves and on fruit (Ferris 1941).

ADULT FEMALE

Fig. 1

Description.—Lectotype with area anterior of lobe 3 with 5 lobelike projections (other specimens with 4–6(5) projections). Median lobes separated by space $0.5 \times$ width of median lobe (other specimens $0.4\text{--}0.7(0.5) \times$), with 1 or 2 lateral notches, without medial notch (other specimens with or without 1 medial notch); second lobe with 2 and 3 lateral notches (other specimens 2–3(2) notches), without medial notch; third lobe with 4 and 5 lateral notches (other specimens 2–5(4) notches), without medial notch. Plate formula 2-3-4 (other specimens usually 2-3-3, sometimes 2-2-3 or 2-2-2). Macroduct between median lobes $1.0 \times$ as long as distance between base of median lobe and posterior apex of anal opening (other specimens $0.9\text{--}1.4(1.1) \times$); macroduct in first space 105μ long (other specimens $85\text{--}132(109) \mu$), with 22 large macroduct orifices on pygidium (other specimens 19–26(23) orifices), with 4 macroduct orifices in row beginning between median margin of lobe 3 and interlobular paraphysis in 2nd space (other specimens with 4–6(4) orifices) (Fig. 1B), with 2 macroduct orifices in same row of macroducts anterior of imaginary line drawn between anterior apex of paraphysis attached to lateral margin of lobe 3 and anterior apex of interlobular paraphysis in 2nd space (Fig. 1C) (other specimens with 1–3(2) orifices). Pygidial microducts in clusters on venter of segment 5 with 7 ducts in each cluster posterior of seta marking segment 4 (other specimens with 5–9(7) ducts); prepygidial microducts on venter in marginal or submarginal areas of head (other specimens on head or head and prothorax) and on segments 3 and 4 (rarely with 1 or 2 on segment 2), in submedial areas around mouthparts, anterior of anterior spiracle, and on metathorax (other specimens with microducts also anterior of anterior spiracle and in submedial areas of metathorax, segments 1–2); prepygidial microducts on dorsum in submarginal areas of prothorax to segment 2 (other specimens with dorsal microducts on prothorax or mesothorax to segment 1, 2, or 3). Perivulvar pores total 13 (other specimens 8–13(11) pores). Anal opening located 97μ from posterior apex of anal opening to base of median lobes (other specimens $59\text{--}123(90)$), anal opening located $9 \times$ length of anal opening from posterior apex of anal opening to base of

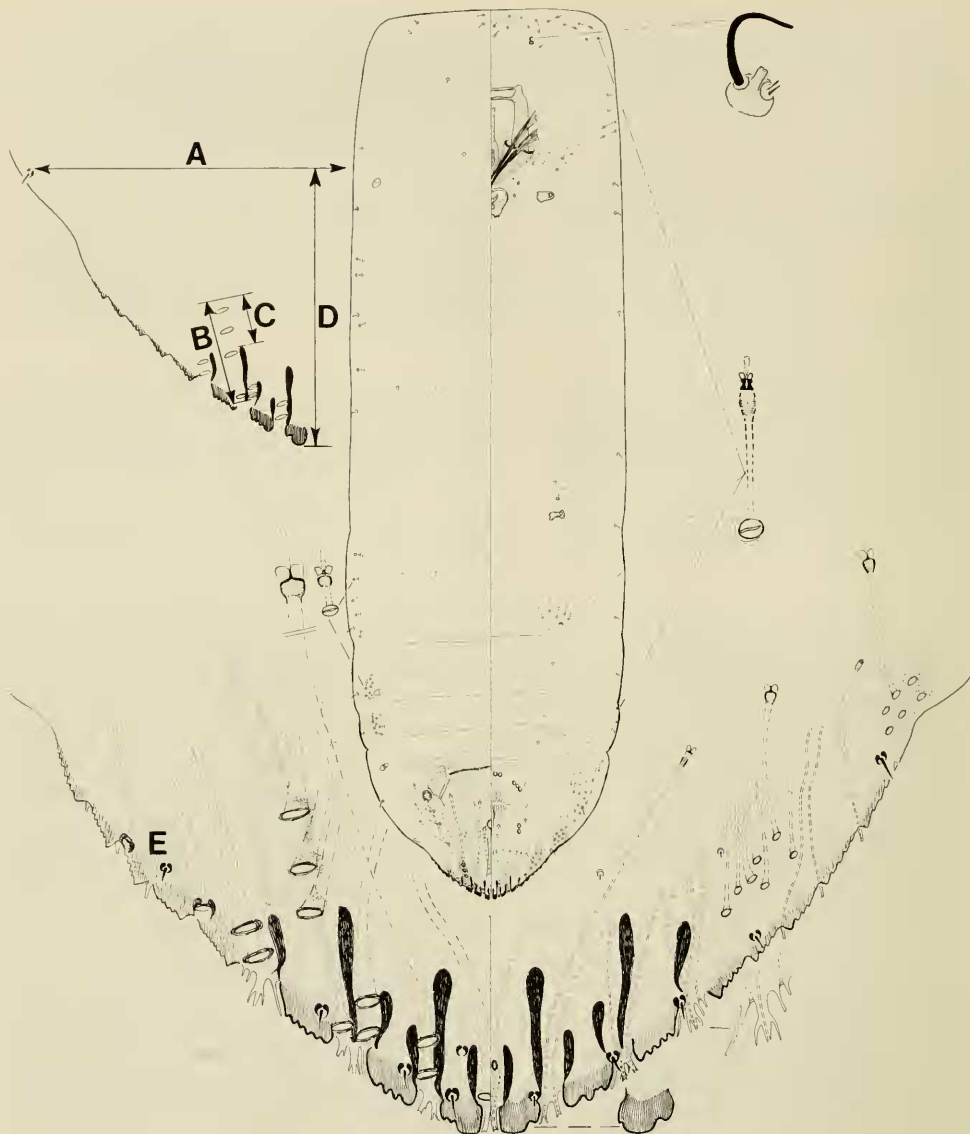


Fig. 1. A to E, *Pseudischnaspis acephala* adult female, 1938. Panama, Chiriqui Prov., ex. *Cavendishia* (Lectotype).

median lobes (other specimens 6–15(8)×), anal opening 11 μ long (other specimens 7–17(13) μ). Marginal area of each side of segment 5 with 2 clusters of ventral microducts on sclerotized areas (other specimens with or without these areas). Pygidium usually relatively broad, ratio of distance of imaginary line drawn between bases of dorsal setae on lateral margin of segment 4 (Fig. 1A) divided by line drawn from midpoint of same imaginary line to posterior apex of median lobes (Fig. 1D) 2.4 units (other specimens 1.8–2.6(2.4) units). Apex of head rectangular with rounded lateral angles (some other specimens with nearly 90° angles). Dorsal sclerotized area adjacent to lobelike projections on segment 5 relatively small.

FIRST INSTAR

Description.—We have examined 4 embryos of this species and could find no differences compared with the crawler of *P. bowreyi* (see "First Instar" in the treatment of *P. bowreyi*).

Discussion.—*Pseudischnaspis acephala* is separated from *P. bowreyi* by having: 8–13(11) perivulvar pores; 4–6(4), macroduct orifices in row beginning between medial margin of 3rd lobe and interlobular paraphysis in 2nd space (Fig. 1B); 1–3(2) macroduct orifices in same row located anterior of imaginary line drawn between anterior apex of paraphysis attached to lateral margin of 3rd lobe and anterior apex of interlobular paraphysis in 2nd space (Fig. 1C); 19–26(23) large macroducts on pygidium; elongate, ventral microducts usually on submarginal areas of segments 3 and 4 only, rarely with 1 or 2 ducts on segment 2; distance from posterior apex of anal opening to base of median lobes 59–123(90) μ ; relatively small sclerotized area adjacent of lobelike projections on segment 5 (Fig. 1E); 5–9(7) microducts in each cluster on sublateral area of segment 5 posterior of ventral seta marking segment 4; *P. bowreyi* has 13–31(23) perivulvar pores; 4–9(6), usually 5–7, macroducts in row mentioned above (Fig. 2B); 2–7(4) macroducts anterior of imaginary line described above (Fig. 2C); 25–36(29) large macroducts on pygidium; elongate, ventral microducts in band on submarginal areas of mesothorax, metathorax, segment 1, or segment 2 to segment 4; distance from posterior apex of anal opening to base of median lobes 91–143(122) μ ; relatively large sclerotized area adjacent of lobelike projections on segment 5 (Fig. 2E); 6–14(9) microducts in each cluster on sublateral area of segment 5 posterior of ventral seta marking segment 4. See Table 1 for a statistical analysis of the above numerical data.

Specimens examined.—In addition to the 19 type specimens mentioned earlier, we examined 48 specimens on 22 slides as follows—MEXICO: On *Chamaedorea* sp., VII-19-1976, R. Park; on *Citrus aurantifolia*, XI-2-1956, Gondeck, CENTRAL AMERICA: Canal Zone-Frijoles, on *Persea* sp. (avocado); V-23-1919, H. F. Dietz, J. Zetek, I. Molino. El Salvador—on *Mangifera indica*, VII-20-1946, Cranford. Nicaragua-Managua, on *Anacardium* sp. (cashew) and *Citrus* sp., IV-28-1959, T. Sequeira; Managua, on palm and *Narcissus* sp., V-5-1959, F. Perez; La Calera, on *Coffea* sp. (coffee), VI-1-1959, R. Bodan. Panama-Anton, on *Cocos* sp. (coconut), IV-1924, J. Zetek. SOUTH AMERICA: Columbia-Espinal, on *Mangifera indica*, II-8-1972, H. E. Martin and F. Mosquera; Fusagasuga, on ornamental palm and ornamental plant, VIII-17-1971, F. Mosquera. Peru-Uchumayo, on *Citrus medica*, VI-18-1919, Bwes.

***Pseudischnaspis bowreyi* (Cockerell)**

Aspidiotus bowreyi Cockerell 1893: 383.

Aspidiotus (*Chrysomphalus*) *bowreyi* Cockerell 1897: 23.

Chrysomphalus bowreyi (Cockerell); Leonardi 1899: 220.

Pseudischnaspis bowreyi (Cockerell); Cockerell 1901: 64.

Aspidiotus (*Chrysomphalus*) *longissima* Cockerell 1898: 439. NEW SYNONYMY.

Chrysomphalus longissimus (Cockerell); Leonardi 1900: 342.

Pseudischnaspis longissima (Cockerell); Cockerell 1901: 64.

Aspidiotus longissima Cockerell; Cockerell 1905: 45.

Pseudischnaspis linearis Hempel 1900: 506.

Aspidiotus linearis (Hempel): Ferris 1941: 45.

Suggested common name.—Bowrey scale.

Type material.—We have examined the syntype series of *Aspidiotus bowreyi* and here designate as lectotype an adult female mounted alone on a slide labeled as follows: Left label “*Aspidiotus bowreyi*/Ckll./ON *Agave rigida*/Hope, Jamaica/Bowrey, Coll. Ckll. Coll./#7831/from Type Material.”; right label “LECTOTYPE/*Aspidiotus bowreyi* (Ckll.)/desig. by/Miller/Davidson & Stoetzel 1984.” The paralectotypes include 1 adult male on 1 slide, 3 second instars and 2 adult females on 1 slide, 2 second instars and 2 adult females on 1 slide, 1 adult female on 1 slide, and 3 adult females on 1 slide. There is a single slide from the type series that contains a scale cover.

We also have examined the syntype series of *Pseudischnaspis longissima* and here designate as lectotype an adult female mounted singly on a slide labeled as follows: Left label “7973./A. longissimus Ckll./(*Type*)/Mango./Frontera, Tab. Mex./June 28 '97.”; right label “LECTOTYPE/*Aspidiotus longissima*/Cockerell/desig. by/Miller/Davidson & Stoetzel 1984.” The paralectotypes include 1 first instar on 1 slide, 1 second instar on 1 slide, 1 adult female and 1 second instar female on 1 slide, and 3 adult females on 3 slides. In addition 3 slides contain 12 scale covers that were collected at the same time as the type series. We also have examined specimens labeled as “cotype material” of *Pseudischnaspis linearis* Hempel and here designate as lectotype an adult female mounted singly on a slide labeled as follows: “*Pseudischnaspis linearis* Hempel/Cotype/Ypiranga, Brazil/A. Hempel,/let. Apr. 28, 1900/Hempel # 79”; right label “LECTOTYPE/*Pseudischnaspis linearis*/Hempel/desig. by/Miller/Davidson & Stoetzel 1984.” The original description gives the host as *Myrcia*. The paralectotypes include 1 2nd instar on 1 slide. All material in this section is in the USNM.

Field characters.—Adult female cover black with blue or purple tinge; cover of newly molted adult female nearly circular; cover of more mature adult female elongate oval with approximately parallel sides. Ventral cover well developed. Male cover similar in texture to female cover except smaller and narrower. Infestations occur on bark and leaves (Ferris 1941).

ADULT FEMALE

Figs. 2–3

Description.—Lectotype adult female of *Pseudischnaspis bowreyi* with area anterior of lobe 3 with 5 lobelike projections (other specimens with 4 or 5 projections). Median lobes separated by space $0.6 \times$ width of median lobes (other specimens $0.3-0.7(0.5) \times$), with 1 lateral notch on specimens without worn lobes, without medial notch; second lobe with 2 lateral notches (other specimens 2–3(2) notches), without medial notch; third lobe with 4 lateral notches on 1 side, 5 on other (other specimens 3–5(4) notches), without medial notch (other specimens rarely with 1 medial notch). Plate formula not clear on lectotype (other specimens usually 2-3-3, sometimes 2-2-3 or 2-2-2). Macroduct between median lobes unclear on lectotype (other specimens with macroduct between median lobes unclear on lectotype (other specimens with macroduct between median lobes 1.0–1.2(1.0) times as long as distance between base of median lobe and posterior apex of anal opening); macroduct in first space unclear on lectotype (other specimens with this

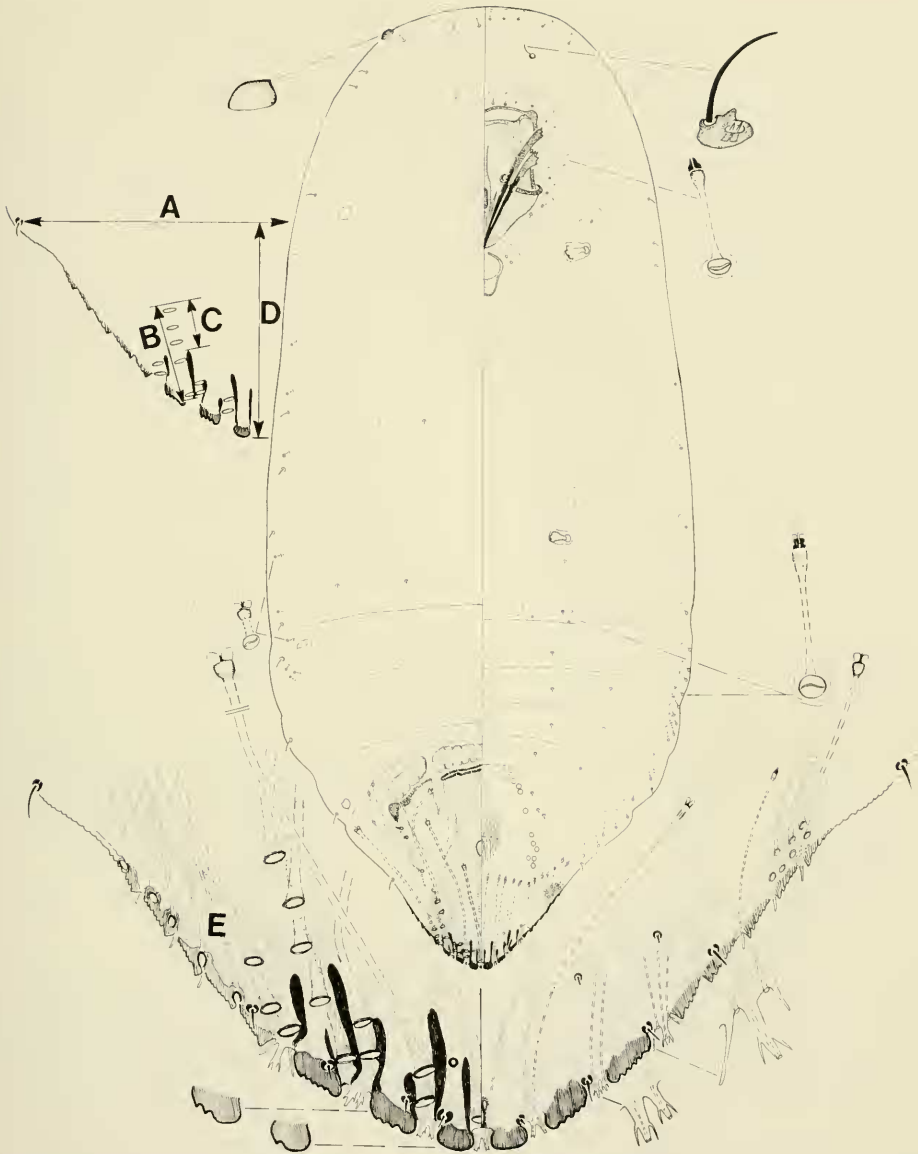


Fig. 2. A to E, *Pseudischnaspis bowreyi* adult female, VIII-19-1976, Guatemala, ex. bromeliad.

macroduct 107–170(149) μ long), with 31 large macroduct orifices on pygidium (other specimens 25–36(29) orifices), with 7 macroduct orifices in row beginning between medial margin of lobe 3 and interlobular paraphysis in second space (other specimens with 4–9(6) orifices) (Fig. 2B), with 5 macroduct orifices in same row of macroducts anterior of imaginary line drawn between anterior apex of paraphysis attached to lateral margin of lobe 3 and anterior apex of interlobular paraphysis in second space (Fig. 2C) (other specimens 2–7(4) orifices). Pygidial microducts in cluster on venter of segment 5, with 7 and 9 ducts in each cluster posterior of seta marking segment 4 (other specimens with 6–14(9) ducts); pre-

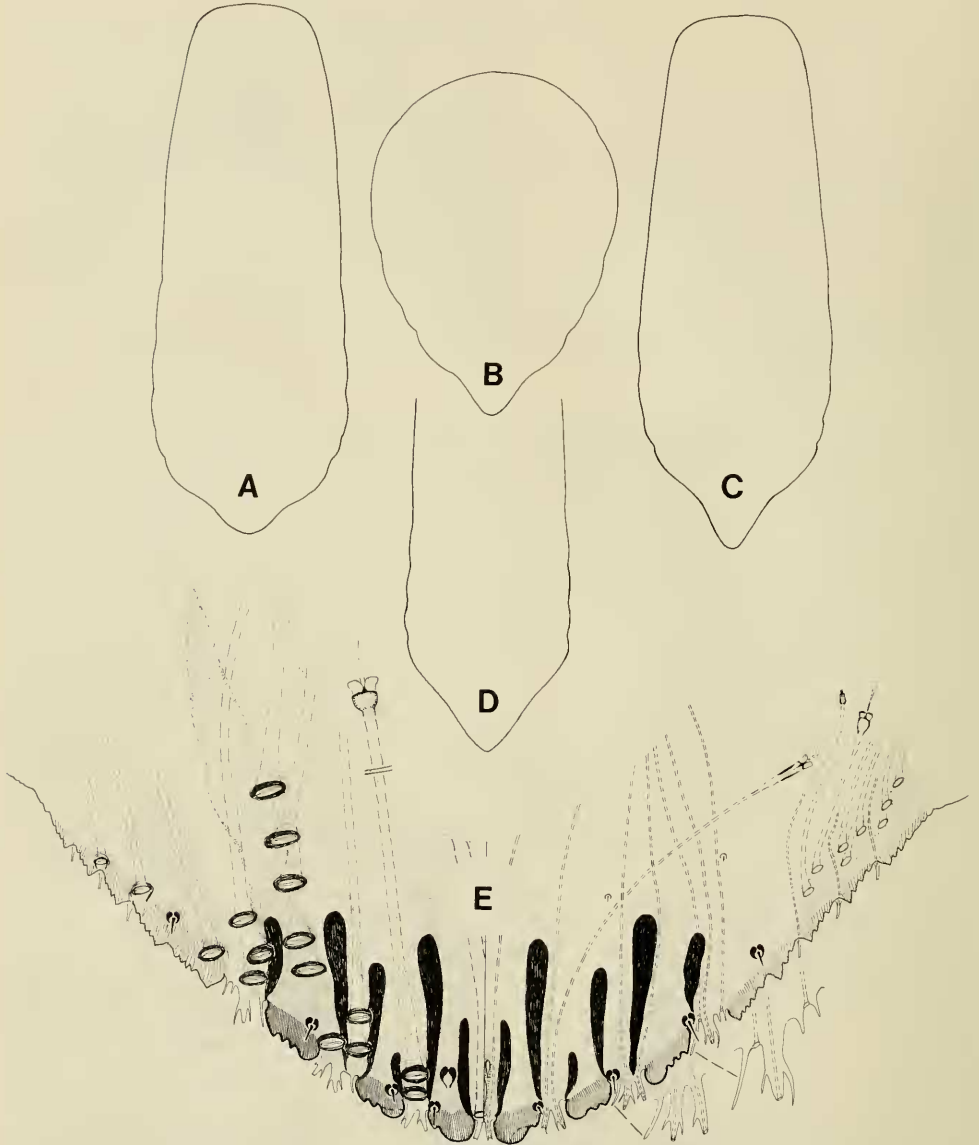


Fig. 3. A and E, *Pseudischnaspis bowreyi* adult female, VI-28-1897, Mexico, Frontera, Tab., ex. *Mangifera*. B, Adult female, I-24-1945, Peru, Lima, ex. "long green plum." C, Adult female, IV-20-79, Mexico, ex. Orchidaceae. D, Adult female, V-15-1973, Colombia, Cachipay Cund., ex. *Pyrus*.

pygidial microducts on venter in marginal or submarginal areas of head (some other specimens with microducts on head and prothorax) and on submarginal areas of metathorax to segment 4 (other specimens with microducts on mesothorax, metathorax, segment 1, or segment 2 to segment 4), in submedial areas around mouthparts, anterior of anterior spiracle, anterior of posterior spiracle and on metathorax (other specimens with submedial ducts on metathorax, segment 1 and sometimes on segments 2 and 3); prepigidial microducts on dorsum in submarginal areas of prothorax to segment 2 (other specimens with dorsal

microducts on prothorax or mesothorax to segment 1, 2, or 3). Perivulvar pores total 26 (other specimens 13–31(23) pores). Anal opening located 110 μ from posterior apex of anal opening to base of median lobes (other specimens 91–143(122) μ), anal opening located $6 \times$ length of anal opening from posterior apex of anal opening to base of median lobes (other specimens $6-11(9) \times$), anal opening 18 μ long (other specimens 11–20(15) μ). Marginal area of each side of segment 5 usually with only single cluster of ventral microducts, ducts on sclerotized area (other specimens with or without sclerotized area). Pygidium usually relatively narrow, ratio of distance of imaginary line drawn between bases of dorsal setae on lateral margin of segment 4 (Fig. 2A) divided by line drawn from midpoint of same imaginary line to posterior apex of median lobes (Fig. 2D) 2.2 units (other specimens 1.4–2.4(1.9) units). Apex of head usually broadly rounded. Dorsal sclerotized area adjacent to lobelike projections on segment 5 relatively large (Fig. 2E).

Discussion.—*Pseudischnaspis bowreyi* is morphologically diverse, particularly in body and pygidial shape (Fig. 3, A–D), but seems to be a single variable species. We were somewhat dismayed when we examined the type series of *P. longissima*, because specimens in the series have a very broad pygidium (Fig. 3, A and E) and 2 distinct clusters of ventral microducts on the submarginal areas of segment 5. These states are quite different from their homologues in the type series of *P. bowreyi*. However, after studying more than 250 specimens of *P. bowreyi* and “*P. longissima*” we could find no consistent difference. Further, we were unable to find any combination of characters that might be used to distinguish these 2 hypothesized taxa. For a comparison of *P. bowreyi* with *P. acephala* see the discussion section of *P. acephala*. The specimen illustrated is not part of the type series of *P. bowreyi* but has been compared with the type and is conspecific with *P. bowreyi*.

FIRST INSTAR

Fig. 4

Description.—Mounted, 0.2–0.3(0.2) mm long, 0.1–0.3(0.2) mm wide. Dorsum with setae and ducts as illustrated. Pygidium with 2 large lobes and 2–3(3) additional fringed, lobelike structures associated with marginal ducts; 2nd lobe with 2–3(3) notches; 3rd lobe with 2–5(3) notches. Plates between median lobes relatively conspicuous, with 5–6(5) tines; 2 plates between lobes 2 and 3 each with 2–4(3) tines. Posterior marginal ducts conspicuously larger than others, duct between 2nd lobes 25–30(28) μ long, duct anterior of 3rd lobe 11–15(12) μ long. Anal opening 5–7(6) μ long, distance from posterior apex of anal opening to base of 2nd lobes 20–30(25) μ , distance from anal opening to base of 2nd lobes/length of anal opening 3.3–5.0(4.2).

Venter with long apical seta 35–70(48) μ long. Area between antennae with 0–2(1) sclerotized tubercles. Legs with hind trochanter + femur 25–43(33) μ long, tibia + tarsus (excluding claw) 18–28(22) μ long; trochanter + femur/tibia + tarsus 1.4–1.9(1.5); tarsi of male with sensillum; each tarsus and claw with 2 capitate setae extending to or beyond claw apex. Antenna 5-segmented, 70–90(78) μ long, apical segment 45–58(53) μ long; antennal length/apical segment 1.3–1.6(1.5); distance from apex of antenna to distal sensory seta 15–30(24) μ ; apical antennal segment with 2 sensilla, 1 usually located near base of distal sensory seta occa-

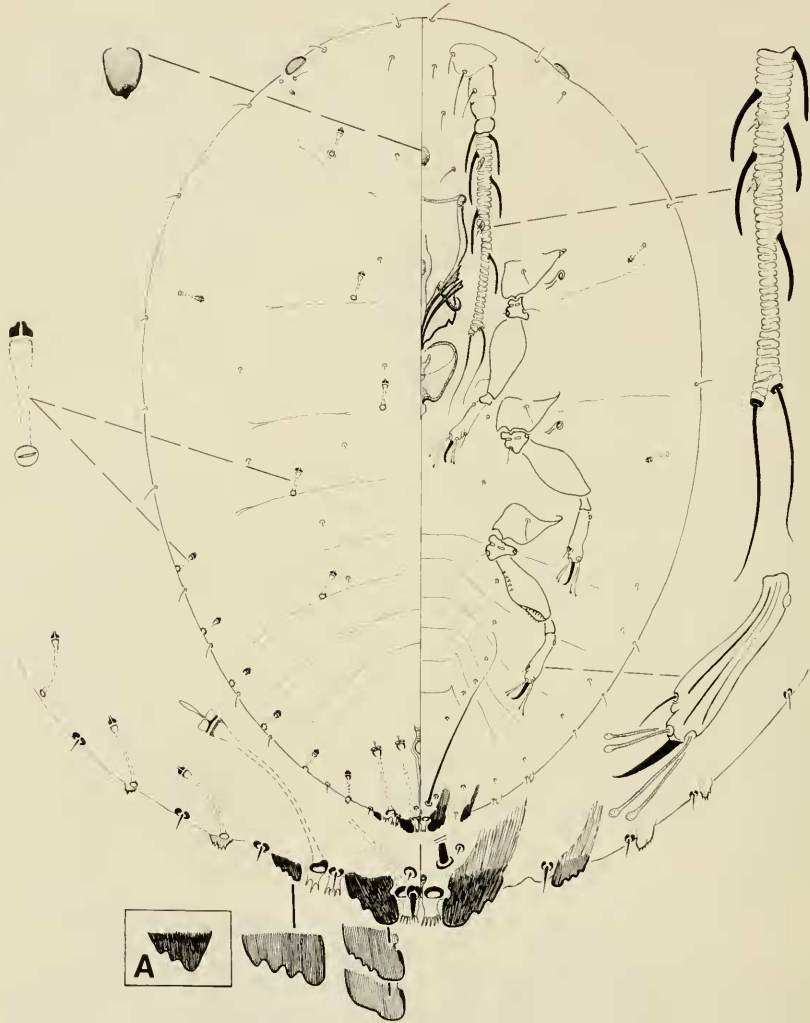


Fig. 4. *Pseudischnaspis bowreyi* female crawler, VII-17-25, Brazil, ex. bromeliad. A. Composite third lobe of *Melanaspis obscura* and *M. tenebricosa*.

sionally more proximal (Fig. 4), other near base of next proximal seta on same side of antenna.

Description based on 8 embryos from 8 localities.

Discussion.—We have been unable to distinguish between the first instars of *P. bowreyi* and *Melanaspis aliena*. Comparisons with 3 other species of *Melanaspis* have provided some interesting results. The first instars of *Pseudischnaspis bowreyi*, *Melanaspis aliena*, and *M. smilacis* share several unusual characters. All have large, fringed plates between the second lobes; 2 fringed plates in the space between lobes 2 and 3; trapezoidal-shaped 3rd lobes; fringed, lobelike processes anterior of lobe 3; usually have mediolateral setae absent from abdominal segments 1 and 2 on the female; usually have mediolateral setae absent from abdominal segment 1 and present on abdominal segment 2 on the male. The first

instars of *M. obscura* and *M. tenebricosa* have small plates that are simple or consist of only 2 or 3 tines between the 2nd lobes; 1 simple plate or no plate in the space between lobes 2 and 3; triangular-shaped 3rd lobes (Fig. 4A); simple, lobelike processes anterior of lobe 3; usually have mediolateral setae absent from abdominal segment 1 and present on segment 2 on the female; usually have mediolateral setae present on segments 1 and 2 on the male. Males of all species examined have a tarsal sensillum, while females lack this structure. Chaetotactic sexual dimorphism was first demonstrated by Stoetzel and Davidson (1974a); sensilla sexual dimorphism was first suggested by Howell and Tippins (1977).

The first instar of *P. bowreyi* and *Melanaspis aliena* differs from that of *M. smilacis* by having notches on the 2nd lobes restricted to the lateral margin, the sensilla on the apical antennal segment in the central and proximal portion of the segment, length of trochanter + femur/tibia + tarsus (excluding claw) 1.1–1.9(1.5), usually having 1 or 2 tubercles between the antennae; *M. smilacis* usually has notches on the medial and lateral margins, has the sensilla on the apical antennal segment in the central and distal portion of the segment, length of trochanter + femur/tibia + tarsus (excluding claw) 1.2–1.4(1.3), without tubercles between antennae.

ADULT MALE

Fig. 5

Description.—Mounted, 0.8–0.9(0.9) mm long, 0.2–0.3(0.3) mm wide.

Dorsum with setae as illustrated except on abdomen where variable; marginal, and submarginal setae as follows: Segment 1 with 0–1(1) on each side of body, segment 2 with 0–1(1), segment 3 with 0–1(1), segment 4 with 0–2(1), segment 5 with 2, segment 6 with 2, segment 7 with 2–3(3), segment 8 with 2–4(4); mediolateral setae usually restricted to segment 2 (on 1 side of 1 specimen 1 seta also on segments 1 and 4, other side of same specimen normal). Abdominal sclerotization weakly indicated. Metathorax with postnotum not sclerotized. Mesothorax with postnotal membranous area with longitudinal striation, scutellum 143–150(147) μ wide, foramen 7–10(8) μ wide, scutellum/foramen 15–20(18). Prothorax with posttergite inconspicuous, pronotal sclerite absent. Head occasionally with weak extension of midcranial ridge, posterior angle of postoccipital ridge 105–126(114) degrees, transverse median body of ridge 35–37(37) μ wide, anterior arms weakly developed forming triangular angle. Dorsal eye 25–37(32) μ in diameter.

Penial sheath apically acute, 237–270(259) μ long; greatest width/length 0.21–0.22(0.21); aedeagus from distal end of basal rod to apex 227–253(239) μ long; anal opening inconspicuous.

Venter with setae as illustrated except mediolateral setae variable as follows: Segment 3 with 0–1(0) on each side of body, segment 4 with 0–1(0), segment 5 with 1–2(1), segment 6 with 1–2(2), segment 7 with 2. Abdominal sclerotization weakly indicated. Metathorax with conspicuous precoxal ridge, metasternum weakly developed. Mesothorax with basisternum partially divided medially. Prothorax with prosternum well developed medially, transverse ridges slightly produced, posterior sclerotic area represented by dermal reticulation only. Head with narrow midcranial ridge terminating posteriorly in weakly sclerotized plate, postocular ridge separate from preoral ridge, without noticeable ventral plates, cranial

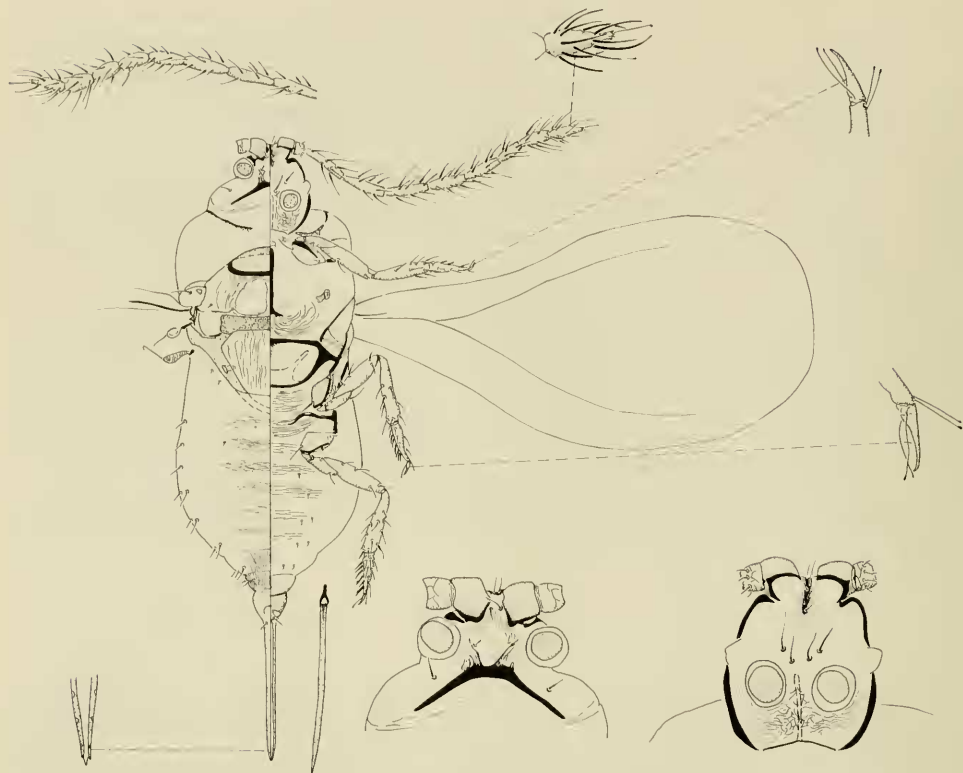


Fig. 5. *Pseudischnaspis bowreyi* adult male, III-1970, Puerto Rico, San Juan, ex. *Agave*.

apophysis not divided apically, 43–60(51) μ long. Ventral eye 25–35(30) μ in diameter. Ocelli conspicuous.

Front legs 310–355(337) μ long, middle legs 313–353(338) μ long, hind legs 340–373(354) μ long; length of hind tibia/tarsus 1.4–1.5(1.4); setae hairlike, bifurcate on inner margin of tarsus, spurs absent; trochanter with 4 sensilla, tarsus with 1; tarsus 2-segmented; digitules similar on each pair of legs, tarsal pair capitate, not reaching tip of claw, claw digitules capitate, extending beyond tip of claw. Antennae 434–460(446) μ long, body 1.9–2.0(2.0) times length of antennae, 10-segmented, 3rd segment 1.3–1.5(1.4) \times longer than apical segment; setae absent from segment 1; proximal seta on 3rd segment 40–53(45) μ long, sensillum not seen on segment 2; with 15–16(15) setae on segment 10 counting capitate seta, excluding sensillum; segment 10 with apical capitate seta and at least 1 more capitate seta. Wing 564–682(612) μ long, 279–316(296) μ wide, wing length/width 2.0–2.2(2.1).

Description based on 5 specimens from 2 localities including a paralectotype.

Discussion.—Of the adult males described by Ghauri (1962), *Aspidiotus destructor* (Signoret) seems to be most similar to the male of *Pseudischnaspis bowreyi*. The former can be separated by having: The anterior arms of the postoccipital ridge nearly parallel forming a rectangle; the legs each with the tarsal and claw digitules represented by a short setiform digitule and a long capitate digitule; 1 mediolateral seta on each side of the dorsum of segments 1 and 2; the prosternum

narrow, with no lateral development of the transverse processes; the mesosternum with a complete median ridge; and by usually having no mediolateral, ventral setae on segment 5, 1 on segment 6, and 2 on segment 7. *Pseudischnaspis bowreyi* has: The anterior arms of the postoccipital ridge diverging anteriorly forming a triangle; the legs each with 2 elongate, capitate tarsal digitules and 2 elongate, capitate claw digitules; 1 mediolateral seta on each side of the dorsum on segment 2 only; the prosternum relatively broad, with a slight lateral development of the transverse processes; the mesosternum with an incomplete median ridge; and by usually having 1 mediolateral, ventral seta on segment 5, 2 on segment 6, and 2 on segment 7.

Males of *Melanaspis* are similar to males of *Pseudischnaspis*. Differences are found in overall size and in setal patterns, but obvious differences have not been observed in reticulate patterns, sizes and shapes of sclerites, or presence or absence of ridges. The male of *Melanaspis obscura* differs by having relatively short antennal setae (proximal seta on third segment 20–33(25) μ long), 3–5(4) clubbed setae on tenth segment of antenna excluding apical seta, 1–3(2) setae in the membranous area near the tegula, penial sheath 415–487(452) μ long, 2–3(3) marginal or submarginal setae on each side of segments 5 and 6, 1 mediolateral seta on the dorsum of segment 1, hind legs over 480 μ long, antennal segments broad (3rd segment 2.5–3.7(3.3) \times as long as wide). In comparison *Pseudischnaspis bowreyi* has long antennal setae (proximal seta on 3rd segment 40–53(45) μ long), 0–1(1) clubbed setae on tenth segment of antennae excluding apical seta, 1 seta in the membranous area near the tegula, penial sheath 237–270(259) μ long, 2 marginal or submarginal setae on each side of segment 5 and 6, usually without a mediolateral seta on the dorsum of segment 1, hind legs less than 400 μ long, antennal segments narrow (third segment 4.0–4.8(4.3) \times as long as wide).

The male of *Melanaspis tenebricosa* has the apex of the penial sheath bluntly rounded, 2–3(2) clubbed setae on the tenth segment of the antenna excluding the apical seta, penial sheath 275–307(293) μ long, 1–2(2) genal setae, 1–2(2) submedial setae on each side of venter of segment 5, and 2 marginal or submarginal setae on each side of segment 4. *Pseudischnaspis bowreyi* has the apex of the penial sheath apically acute, 0–1(1) clubbed seta on the tenth segment of the antenna excluding the apical seta, penial sheath 237–270(259) μ long, 1 genal seta, 1–2(1) submedial setae on each side of venter of segment 5, and 0–2(1) marginal or submarginal setae on each side of segment 4.

The male of *Melanaspis smilacis* is remarkably similar to the male of *Pseudischnaspis bowreyi*. Both usually lack the mediolateral setae on segment 2; both have the tenth antennal segment without capitate setae (excluding apical seta) or with 1 such seta with the club so small that it is nearly impossible to see; and both have the same setal patterns. *Melanaspis smilacis* usually has a definite dorsal extension of the midcranial ridge, the length of the body/length of the antenna 1.4–1.8(1.6), and the length of the antenna 471–639(573) μ . *Pseudischnaspis bowreyi* has the dorsal extension of the midcranial ridge absent or weakly indicated, the length of the body/length of the antenna 1.9–2.0(2.0), and the length of the antenna 434–460(446) μ .

Comparison of adult males of *Melanaspis aliena* with those of *Pseudischnaspis bowreyi* supports the conclusion of a close relationship demonstrated by other instars. The male of the former differs by having much longer setae on the antennae

(proximal seta on 3rd segment about 70 μ long), body about 1.1 mm long, and penial sheath about 325 μ long. The latter has shorter setae on the antennae (proximal seta on 3rd segment 40–53(45) μ long, body 0.8–0.9(0.9) mm long, and penial sheath 237–270(259) μ long.

Specimens examined.—We have examined about 250 specimens on 170 slides. A synopsis of pertinent collection data is as follows: UNITED STATES: Florida—Homestead (on *Lagerstroemia lanceolata*, 1977); Key West (on *Rosa* sp. and *Vitis* sp., 1890 to 1921); Miami (on *Coccoloba uvifera*, *Persea* sp., and *Psidium guajava*, 1909–1980). Missouri—Shaw Botanic Garden, St. Louis (on *Agave* spp. and *Yucca aloifolia*, 1921). New York—New York Botanic Garden, New York (on *Agave decipiens* and *Yucca aloifolia*, 1921 to 1934). MEXICO:—(on *Beaucarnea*, cactus, *Citrus*, *Dracaena Ficus*, *Hylocerus*, Orchidaceae, *Mangifera*, *Persea*, *Yucca*, 1897 to 1977). CENTRAL AMERICA: Belize—(on *Tillandsia*, 1976). Costa Rica—(on *Carya*, *Persea*, *Prunus*, *Rosa*, 1932 to 1951). Guatemala—(on “bromeliad,” *Tillandsia*, 1976 to 1979). Honduras—(“bromeliad,” *Tillandsia*, 1976). Nicaragua—(on *Citrus*, *Pyrus*, *Theobroma*, 1959). Panama—(on *Tillandsia*, 1951). SOUTH AMERICA: Brazil—(on *Bromelia*, “bromeliads,” “*Holocalyx*,” 1946 to 1978). Colombia—(on *Eucalyptus*, *Pyrus*, 1973 to 1977). Ecuador—(on *Persea*, 1925). Peru—(on “bromeliad,” *Hibiscus*, “long green plum,” *Musa*, *Nerium*, “orchid,” *Passiflora*, *Rosa*, 1910 to 1979). Venezuela—(on *Cattleya*, 1943). WEST INDIES: Barbados—(on *Rosa*, 1935). Bermuda—(on *Agave*, 1921 to 1936). Cuba—(on *Agave*, *Aloe*, *Annona*, *Ciba*, *Hibiscus*, *Hylocereus*, *Jasminum*, *Mangifera*, *Phoenix*, *Psidium*, *Rosa*, 1917 to 1955). Jamaica—(*Agave*, 1893–1974). Puerto Rico—(on *Agave*, *Annona*, *Coccoloba*, *Rosa*, *Spondias*). St. Croix—(“bromeliad,” 1976). St. Thomas—(on *Agave*, *Poinciana*, *Psidium*, 1924–1975). Trinidad—(*Euphorbia*, 1975).

SUMMARY AND DISCUSSION

Several conclusions merit special attention.

(1). *Pseudischnaspis* now includes two species. *Pseudischnaspis longissima* is believed to be a broad-pygidium extreme of *P. bowreyi* and is synonymized for the first time. *Melanaspis aliena* virtually is inseparable from *Pseudischnaspis bowreyi* in the first instar, is difficult to separate in the adult female except with old mature specimens, and apparently is easily distinguished in the adult male by the length of the antennal setae.

(2). An unusual amount of intraspecific variation was detected in both *Pseudischnaspis acephala* and *P. bowreyi*. In the former the median lobes either have a medial notch or lack it. In several paralectotypes a single specimen has one median lobe with the medial notch, whereas the other lobe completely lacks this notch. In *P. bowreyi* the shape of the pygidium varies from the broad form described as *P. longissima*, to the narrow form typical of the traditional concept of *P. bowreyi*. In several long series of specimens we found both pygidial forms with numerous intergrades. No correlation was found between the degree of body elongation and pygidial shape.

(3). Chaetotactic sexual dimorphism in *Pseudischnaspis bowreyi* is different from what has been reported in other aspidiotine armored scales. The usual aspidiotine setal arrangement is for the female to be without dorsal setae mediolaterally on the dorsum of segments 1 and 2 and for the male to have these setae.

In *P. bowreyi* the female lacks mediolateral setae, typical of other aspidiotines, but the male has mediolateral setae on segment 2 and lacks them on segment 1. The same setal patterns were found in *Melanaspis aliena* and *M. smilacis*.

Chaetotactic sexual dimorphism in *M. obscura* and *M. tenebricosa* was quite different. The female usually has mediolateral setae absent from segment 1 and present on segment 2. The male usually has mediolateral setae present on segments 1 and 2.

(4). Based on our examination of just a few species of *Melanaspis*, it is evident that generic concepts of *Pseudischnaspis* and *Melanaspis* need to be reexamined. Our hypothesis, based on characteristics of first instars and adult males, is that *M. aliena*, *M. smilacis*, and *Pseudischnaspis bowreyi* form a group of species and that *Melanaspis obscura* and *M. tenebricosa* form another group. It is evident that further study is needed.

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